It is also called by the Americans the Water Beech; the latter possibly from its durability in water, which property it possesses to an eminent degree. In the structure, colour, and other general particulars, the wood much resembles beech, but the larger transverse septæ are more plentiful, and present very beautiful flowers when the wood is cut favourably for such derelopement; it is harder than the oriental, but works easily and stands very well.

79. In both species, the tree appears to be exempt from the ravages of insects, which renders it the better adapted for purposes where beauty of foliage is desired.

80. Teak or Indian Oak.—This tree is a native of mountainous parts in India; it grows with rapidity, to a great height, wide-spreading and erect, affording most useful timber, which requires but little seasoning, and has very little shrinkage: being light, strong, durable, and easily worked, it is well adapted for the purposes of both the house and ship carpenter. In strength and stiffness it excels our British Oak, and is said to have been known to last firm where even the latter has failed: it is oily in its nature, and yields tar of good quality. It is from both the Malabar and Coromandel coasts, but that from the former is the most highly esteemed, and at Bombay is much used for ship-building, for which it is well adapted. There is a kind, it is said, in Hindostan, of which the wood is of a more compact texture, and heavier than that of the common teak; being likewise beautifully veined, and altogether well suited for furniture. The Teak tree is, in the Birman empire, the lord of the forests (which are large and numerous), and is esteemed superior to European oak.

81. Turtosa or African Teak, also sometimes called African Oak, is imported from Sierra Leone; it is a compact and hard but rather brittle wood, similar in colour to oak, but in grain more uniform. It has no larger transverse septæ, but the smaller are strong and abundant; the annual rings are visible but not distinct; it is more difficult, and consequently more expensive to work than British Oak, but nevertheless is used to a considerable extent; and is, indeed, thought suitable for those purposes to which that timber is usually applied, both as regards house and ship carpentry. The wood tastes bitter, but is inodorous when dry; it is disposed to split internally in the seasoning, and inclines also to shakiness.

82. Cowrie.—This timber is from a large cone-bearing tree of the pine species, and is imported from New Zealand. The wood is in colour somewhat similar to cedar, with some of that silky lustre which is observable in several of the pines: it has no large transverse septæ, is straight and fine in the grain, and uniform and close in texture. The annual rings consist of two parts, light and soft, and a harder and darker, with resin in considerable abundance; it is not much liable to shrink, holds very well with glue, and seems to stand the weather tolerably. It is used by ship-builders for masts and spars, and, is excellently suited for internal joinery.

(To be continued.)

ON THE CONDUCTING AND ABSORBING POWERS OF ROCKS AND STONES.

BY HENRY G. MONTAGUE, ESQ., PROFESSOR OF NATURAL PHILOSOPHY.

(Continued from p. 429.)

The processes of Nature, by which concrete masses of rock are produced, furnish many valuable hints to the builder, not only for making the most durable cements, but also for remedying the defects of those concrete masses which are most generally employed for building purposes, but which, from their porosity, or from the preponderance of lime, are apt, when they come in contact with atmospheric air, to fall into rapid decay. In the organic kingdom, as is palpably manifest to all men, the most solid portions of the animal frame, as shells, bones, and horns have a cementing base of gelatinous matter; and the more intimate the union of this matter with the earths and other substances, the harder, the more compact, and consequently the more durable, are the members of the organic body. The coral tribes which pass into limestone from the living state have all of them this gelatinous or mucilaginous base, which is analogous to, and passes into the state of silica; many of them have also peculiar oils, which are compounds of carbon and hydrogen, and these components also enter into and become identified with the solid ponderable rock; the presence of iron, magnesia, excess of animal oils, &c. gives characteristic quality to the rock: thus we have magnesian limestones, bituminous limestones, ironstone, &c. On the other hand, when rocks are formed by the concretion of sedimentary deposits, the cementing material of the various masses is ever varying in its nature, being carbon, silica, or alumine, as the case may be, but under all circumstances it is mineralized organic matter. The shell of the oyster is chiefly composed of phosphate and carbonates of lime, every atomic part of which is surrounded by a firm membranous matter, which constitutes the strength of the shell, for mere compact solutions of calcareous matter and water would embrace neither strength nor durability. All cements must, therefore, have some common basis, possessing adhesive qualities, and conforming in character to the objects which they embrace, otherwise the atmospheric or aqueous power acting upon them must inevitably decompose their masses.

All rock which is simply concrete, and not crystalline, is none other than a natural cement; and the uncertainty of its composition, and character for durability, attest the accident of circumstances which brought its material together. Take for instance Portland stone: under this name we have a variety of material, the nature of each being determined by the predominating material, which is either lime or alumine, or an union of these with silica; the first, a mere agglutinated mass of calcareous *cermes* and other lime secreting species, with chalky deposits, and having little cohesion of its parts, like ill-mixed mortar, soon falls to pieces:* the second being calcareous matter blended with argillaceous earth, has a better cement or base, and is more durable; but under atmospheric influences this also readily parts with its lime, and consequently disintegrates: the third quality produces stone at all times better than the other two, and increasing in value, so far as regards durability, as silica becomes its most prevalent material.

The more silex there is in concrete masses, the more silex there is used in making artificial cements, the more durable is the material. Silex is almost indestructible, air makes no change in it; by absorbing water, it sometimes assumes the crystalline state, but it cannot be dissolved in water by chemical methods; the acids to which it may be exposed have no effect on it, and uniting with alumine, it renders the latter harder and more durable. Buildings built of flints, if the cement were equally durable, would be indestructible in this climate, for contrary to other earths they love a moist climate, and more tenaceously retain the bodies with which they are mechanically united in temperate and cold, than in tropic regions. Formed by atmospheric influences, they are by nature calculated to resist them.

The durable quality of concrete bodies having a siliceous base is palpably manifest in the basalts, porphyries, clinkstone, and other varieties common to this country, and would have the effect of bringing them more universally into use, were it not for the vast expense of preparing them; in many of the crystalline varieties of rock, their durability is less sensibly exhibited, in consequence of the slight cohesion of the crystalline particles.

Natural concretes almost always attain greater cohesion and solidity of parts than artificial cements; but still there are many exceptions to this rule, and I have seen cements in India having a gem-like hardness. I remember in particular witnessing the pulling down of an old fortress in the southern part of the Deccan, where the cement was so exceedingly hard as to turn the points of the iron implements, and it was found much easier to break the stones to pieces. A great deal, it is true, depends upon climate, but much is really due to the care and attention bestowed in making these cements. The very best shell lime is used, and this shell lime contains a great deal of siliceous matter; equal quantities of this and the very fine sand of the country is used, the lime being first slaked with water; they are then left for three days. A liquid is then made of 2 lb. sugar (goor) to one gallon of water, and this is sometimes boiled with vegetables of a gelatinous nature; to the lime and sand is added chopped hemp, and the whole mixture is then well stirred together into a very fluid state; some add milk to this mixture, and others increase the quantity of sand. When used, the bricks or stones are bedded in layers of it, as thin as possible, and if the material is of a spongy nature, it is saturated with the mixing fluid.

This is following Nature in her course, the natural cements or concrete rocks being of analogous composition; the carbonaceous matter and the silica conjointly forming in union the cementing base, and in both the natural and artificial product, enveloping, as in the shell of the fish, every atomic particle of the lime. In Persia, most of the concrete rocks abound with bitumen, and it is here, therefore, that bitumen is employed in making cement, and we frequently read of the bitumen being employed in ancient structures in this and also all the surrounding countries, being built of brick, stone, or marble, and cemented with bitumen. But this must not be taken literally, for bitumen alone in these hot dry countries would be of little real use, but when it forms the cementing base of the lime, it then becomes exceedingly hard and durable.

I have already stated that rose jasper, and many other conglomerate masses present, in the first instance, the appearance of a simple conglomerate mass of siliceous pebbles held together by a natural cement, bearing great resemblance to that made by artificial means; at first very slightly adhesive, but gradually becoming indurated, and finally silicifying, and thus becoming one and inseparable from the general mass; in fact, when the change is perfected, it appears but as one variegated stone. To effect this change, time and intense atmospheric heat are necessary, but simple silicification, or, as it is wrongly termed, petrification, takes place in every part of the world; and in this country, in particular, we find Nature incessantly occupied in forming conglomerate masses from the commingled masses of matter constituting strata, or in changing the isolated bodies and fragments of bodies of animals and vegetables into stone. If, then, Nature can cement chalk, or a bone, or a tree, into flint, securing it, by this means, against the future ravages of time; why should not men, by studiously following Nature in her operations, attain the same power, and by the same means? Were Bath stone saturated with liquid silica, or with alumine and iron instead of with water, it would speedily be changed into an indestructible body, resisting alike the atmosphere and the waters; and there is not the least reason, other than the present ignorance of man, why the quarried and sculptured stone should not be saturated with a fluid compound which would at once alter its very nature and qualities.

Man has much to learn concerning the earth on which he treads; his imitations of nature are too often feeble and imperfect; he beholds the fluid drop converted into a stone; he finds the common earth alumine converted into topaz, ruby, and emerald; carbon converted into coal and into diamond; he beholds silica congealed in a thousand forms, as agate, crystal, quartz, and crystalline, and amorphous rock: but of the origin of silica he knows nothing, although it is the most abundant material of the earth; the processes of nature are continually liquifying it for the uses of the vegetable kingdom; and that its elements are abundantly diffused in liquids, is evidenced by the enormous processes of congelation and concretion continually taking place.

It is evident that there is no other cementing base so capable of resisting the action of the atmosphere or of water, as silica; of the carbonates and sulphates of lime, including the

[* The kinds containing oyster and other shells are frequently found the most durable, a small portion only of the cement disappearing while the shells remain sharp and slightly prominent, as may be seen down the weather-line of the columns of St. Paul's Cathedral, the stone of which was selected with such admirable care that the greater portion of its masonry remains exhibiting the finest marks of the tools used from 140 to 170 years ago. On its northern and eastern sides hardly a time-speck is to be observed upon its delicate and extraordinary carvings.—Ed.]

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